Physics 323. Problem set III. Thursday, April 17, 2003

DUE THURSDAY, APRIL 24, 2003

Problem 1 (30 points).

A particle of charge e is at rest in the system K', moving at constant speed v with respect to the system K, along the x axis.

a. What are the electric and magnetic fields measured at any time in the system K' ?
b. What are the electric and magnetic fields measured at the time $t = 0$ in the system K ?
c. What is the direction of the electric field with respect to the particle ?
d. What would be the direction of the electric field at any time t ?
e. What happens when $v \to 1$? What would be the force felt by a particle of charge e' at rest and separated by a distance r from the moving charge along the axis of motion, when $v \to 1$? How can this be explained from the point of view of the observer in the system K' ?

Problem 2 (30 points)

For uniform and constant magnetic and electric fields, one can always find a system of reference in which they are parallel to each other.

a. When is this assertion not true ? Why ?
b. In the general case, in which the above holds, determine the velocity of the system of reference in which the electric and magnetic fields are parallel to each other.
Hint: Choose a system moving in a direction perpendicular to both magnetic and electric fields.
c. Is the reference frame chosen in point b. unique ? Explain why.

Problem 3 (40 points)

Determine the relativistic motion of a particle moving in parallel and uniform electric and magnetic fields.
a. What happens when $|\vec{E}| \to 0$?
b. What happens when $|\vec{B}| \to 0$?